Test Procedure for

LITHIUM DOSAGE DETERMINATION USING ACCELERATED MORTAR BAR TESTING

TxDOT Designation: Tex-471-A

Effective Date: August 2009

1. SCOPE

1.1 Lithium compounds have been shown to control expansion due to alkali-silica reactivity (ASR). This test method outlines the procedure necessary to determine the ideal dosage of lithium nitrate ($LiNO_3$) for use as an admixture in fresh concrete.

1.1.1 The procedure is based on the paper *Use of the Accelerated Mortar Bar Test to Evaluate the Effectiveness of $LiNO_3$ Against Alkali-Silica Reaction – Part 2: Comparison with Results from the Concrete Prism Test*, written by C. Tremblay, M. A. Bérubé, B. Fournier, M. D. Thomas, K. J. Folliard, and P. C. Nkinamubanzi.

1.2 The values given in parentheses (if provided) are not standard and may not be exact mathematical conversions. Use each system of units separately. Combining values from the two systems may result in nonconformance with the standard.

2. APPARATUS

2.1 Refer to ASTM C 1260 for test apparatus.

3. TEST SPECIMEN PREPARATION

3.1 Refer to ASTM C 1260 for sampling and preparation of test specimens.

4. PROCEDURE

4.1 For each coarse aggregate, intermediate aggregate, and fine aggregate, perform the following procedures.

4.1.1 Control Test — Refer to ASTM C 1260 for test procedure, except continue taking measurements until 28 days.

4.1.2 Lithium Nitrate Dosage Test — Refer to ASTM C 1260 for test procedure, except for the following.

4.1.2.1 Add a 0.74 ratio of [Li/(Na + K)] to the mixing water as calculated using the following equations. (See Section 5 for an example.)

$$A = C \times \frac{P}{100}$$

Where:

A = alkali content (g)

C = cement content (g)

P = % Na_2O equivalent in cement.

$$d = A \times 4.63$$

Where:

d = dosage of $LiNO_3$ 30% solution added to the mixing water (mL).

$$D = d \times 1.2$$

Where:

D = dosage of $LiNO_3$ 30% solution added to the mixing water (g).

$$W = w - (D \times 0.7)$$

Where:

w = water content (g)

W = adjusted water content to account for water in $LiNO_3$ 30% solution (g).

4.1.2.2 Add a 0.148 ratio of [Li/Na] to the soak solution. To produce 1 L (1000 mL) of soak solution, add 500 mL of 2M Standard NaOH to a 1-L volumetric flask, followed by 28.4 mL of $LiNO_3$, and then add de-ionized water to the 1000 mL mark.

4.1.2.3 Continue taking measurements until 28 days.

5. EXAMPLE

5.1 The following example performs the required calculations of Section 4.1.2.1 for the testing of three mortar bars.

5.1.1 Given:

C = 440 g

P = 0.52%

w = 206.8 g.

5.1.2 Therefore:

$$A = C \times \frac{P}{100} = 440 \times \left(\frac{0.52}{100} \right) = 2.29g$$

$$d = A \times 4.63 = 2.29 \times 4.63 = 10.6mL$$

$$D = d \times 1.2 = 10.6 \times 1.2 = 12.7g$$

$$W = w - (D \times 0.7) = 206.8 - (12.7 \times 0.7) = 197.9g$$

6. CALCULATIONS

6.1 Calculate expansion of each test according to ASTM C 1260,

Where:

E1 = 28-day expansion of the Control Test

E2 = 28-day expansion of the Lithium Nitrate Dosage Test.

6.2 If $\left(\frac{E2 - E1}{E1} \right) < 0.10$, calculate the ratio of [Li/(Na+K)] to use in the concrete as an admixture.

$$Ratio = 1.0 + 0.7\left(\frac{E2 - E1}{E1} \right)$$

6.3 If $\left(\frac{E2 - E1}{E1} \right) \geq 0.10$, the aggregate is an aggregate where conventional doses of lithium have not been found to be effective in controlling ASR, and ASTM C 1293 is recommended to determine lithium dosage.

6.4 Calculate the amount of lithium in gallons needed per pound of alkalis, not to be less than 0.55 gallons per pound of alkalis:

$$G = \left(\frac{Ratio}{0.74} \right) \times \left(4.63 \frac{L}{kg} Na_2O_{eq} \right) \times 0.120$$

Where:

G = gallons of 30% $LiNO_3$ solution per pound of alkalis.

7. REPORT

7.1 Report all information as outlined in ASTM C 1260 plus all additional calculations.

8. ARCHIVED VERSIONS

8.1 Archived versions are available.